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Modular Chromatography Device

The device includes a stacking of chromatographic modules between which one intercalates distribution elements intended to ensure the uniform distribution of the chromatographic liquids into and out of plate of each module. Application to pharmaceutical or agricultural industries.

MODULAR CHROMATOGRAPHY DEVICE

The present invention relates to a device of chromatography and more particularly a modular device of chromatography.

Chromatography is a method usually used in the laboratories to isolate and purify small quantities of a component contained in a complex mixture

The biotechnology explosion, particularly in pharmaceutical and agriculture industries require very selective separations because of the high cost of the products manufactured.

Chromatography has many advantages, and is more and more frequently used, but for the present it used primarily in the laboratory. Now the problem is to extrapolate it's use to industrial scale.

The basic element of this problem is the column. In the description which will follow one will speak about of a chromatography module, the column being a stack of these modules. A vertical tube (out of glass, stainless or plastic), generally of small diameter, contains the chromatography packing (or support, the matrix or gel) made up of porous micro-spheres. This cylinder comprises at its two ends a porous material disc (metal or sintered plastic) to imprison and support the packing and a device which ensures a uniform distribution of the liquid at the entry and the exit. The product to be purified is introduced at one of the ends and circulates vertically.

Thus, for an industrial use, to increase the capacity of the chromatographic column, one can change either on the diameter of the chromatographic column, or the bed heigh, that is, the distance between the two porous discs located at each end of the chromatographic column.

Increasing the diameter of the chromatography column at a constant bed height is causes the problems of mechanical resistance and of uniform distribution of the liquid on all the surface of the support.

Conversely, if one increase the height of the chromatography bed, the speed of crossing of the product and thus the pressure loss increases, involving a higher pressure of the support, which is likely to modify the effectiveness of separation and to reduce output of the column.

Another problem resides in loading and unloading these columns. Indeed, creating a homogeneous bed without air pockets requires precautions and thus a rather long procedure. In the same way, the draining of the column is tiresome and time consuming. All these manual operations harm the productivity of the industrial plant.

Also one of the objects of this invention to provide a device of chromatography,

making it possible to treat large volumes, and to avoid the problems mentioned above. One of the objects in particular is to provide a chromatography device whose effectiveness is constant whatever volumes brought into play. Another object of this invention will appear during the description which will follow.

As, the invention relates to a such modular device of chromatography including at least two chromatographic modules stacked on one another, each module including a porous entry plate, a porous exit plate and containing a chromatography support, characterized in that of each module is connected fluidicly to the next.

Description will be made by referring to the drawings in which:

- the figures 1A, 1B, 1C represent under various angles a chromatography module which can be used in the device according to the present invention,

- figure 2 represents a frame, or holder, in which the chromatography device according to the present invention can be assembled,

- the figures 3A, 3B, 3C represent a chromatography column according to the present invention.

One now makes reference to the figures 1A, 1B, 1C,a diagrammatic representation of an example of modular chromatography which can be used in the device according to the present invention.

The chromatography device according to the present invention is in fact carried out starting from several chromatographic modules of the type of that which will be described thereafter and which one stacks up according to the volumes that one wishes to treat. Indeed, after having been determined at the laboratory the operating conditions, it will be enough to multiply the number of the initial column by the ratio to the flows of each one to obtain the column of desired industrial chromatography.

The chromatography moduler epresented in figure 1 includes a body (1) of parallelepipedic form, preferably, out of molded or extruded transparent or opaque plastic. This body is provided at its ends with two porous plates, lower (3) and higher (5), which hold and support the chromatography packing. These plates, for example, are plastic frits that are heat-welded on the body and two plastic bases molded, lower (2) and higher (4), which ensure the equal distribution of the liquid and, by adequate reinforcements, the mechanical rigidity of the unit.

The product to be purified enters the module by the entry channel (6), passes by the distribution openings (6'), then by the distribution slit (10), and arrives in the distribution box (8), flow out through the porous plate and of the chromatography support. The product leaves other end by using the opposite way. But it is quite obvious that the direction of circulation of the liquid can be reversed; indeed, the circulation of the liquid can be done from top to bottom or upwards; this last mode appears the best

suitable one.

The entry and exit channels are provided with joints(12) (12') to ensure the tight seals between each module.

This module can include a side opening (not shown) to allow filling of the chromatography support, an opening sealed then by heat-welding.

For special applications, in particular for reasons of mechanical resistance or chemical compatibility, a metal construct is possible but the design of it would be different. In particular, because of the cost of such module, it would comprise two dismountable side openings (opposites according to a diagonal) making it possible to discharge and reload the chromatography support. This possibility of reusing the container can also be considered for the plastic modules.

Dimensions of these modules are not limited, one can consider for example a ganmme of 50 mm X 100 mm, 50 X 200, 50 X 500 with heights of bed of 250, 500 and 1000 mm.

It is to be noted in the chromatographic modules of this type, that the pressure losses occur at the sintered plates and very little at the entry channel (6).

Figure 2 represents a frame on which the stacking of modules according to the present invention can be laid out. This frame includes a fixed plate (14), two guide rails, bottom (16) and top (15), a support base (17) and one mobile plate (18) displacing itself on the rails.

An assembly of ties (13), retractable at installation or withdrawal of the modules makes it possible to tighten the modules between the fixed plates and mobile. This tightening ensures good sealing between the modules thanks to the joints (12) and the mechanical resistancel. These same ties, by reducing the cross-wise distortions by their peripheral positioning contribute to the good behaviour in pressure of the modules, which allows reduced thickness of the module wall.

The length of the ties and the guide rails determines the maximum number of modules which one can stack up. It is thus possible to vary the number of modules without any modification, which makes this equipment very flexible.

It is obvious that the shape of the module of chromatography and consequently that of the frame is not limited to the description contained here. Indeed, one can consider modules whose body would be, for example cylindrical, annular or hexagonal. In the case of such modules having a radial symmetry, the entry channel would be axial and the drain peripheral or vice versa.

Figures 3A, 3B, 3C, to which we now will refer in the part of the description which will follow, illustrate the way in which the previosuly described chromatography modules

are stacked.

The chromatography modules (A) used are of the same type as those described in the first part of the description. However, their realization is slightly different. Indeed, these modules are carried out so that the porous plates are located on the side parts of the module, thus allowing bed heights much lower than those obtained in the realization of figure 1, and supporting the stacking of such modules which will be described thereafter.

The stacking of these modules is ensured by the distribution plates (B),produced from molded plastic. These distribution plates are laid out between each module forming the chromatography column, so that each module is surrounded by a distribution plate, including the modules placed at the two ends of the chromatographic column. These distribution plates are presented here as thin layers. They are inserted between two modules they define two parts not communicating between them; one ensuring the distribution of the liquid on the entry disc of the first module (either jsut above, or just below the module, according to whether liquid circulates upwards or from top to bottom); the other part ensuring the evacuation of the chromatographic liquid coming from the second module.

The distribution also comprises baffles (24) which channel liquid in order to distribute uniformly over all the width of the module and help to evenly evacuate the chromatographic liquid. It also comprises embossings (25) to mechanically reinforce chromatographic gels subjected to pressure. Joints (26) and (27) ensure the sealing between the chromatography modules and the distribution plate.

Now let us consider the device of figure 3B with thecirculation of the liquid flow as shown by the arrows. The liquid to be treated is introduced under pressure by the low part of the chromatography column. It is then brought by means of the distribution plate to the entry discs of the chromatography modules forming the column. In the diagram, it crosses the from top to bottom modules and then is recovered and channeled towards the exit of the chromatography column laid out on top of the aforementioned entry column and opposite to the opening of the column. In this mode of realization, the liquid circulates in the modules from top to bottom but it is obvious that the unit can be arranged so that the liquid circulates upwards in the modules. In the same way, the chromatography column can be laid out vertically so that the liquid crosses the modules of chromatography horizontally.

The device which is described is particularly adapted in the case where, because of high pressure resistance limiting chromatography support, the bed height must be low. Such a device makes it possible, indeed, to reduce the size.

CLAIMS

1 - Modular device of chromatography including at least two chromatographic modules that one stacks up on another, each module including an entry plate and an exit plate made out of porous material and containing a chromatography support characterized in that each module contans a distribution plate intended to ensure in a tight way, uniform distribution of the chromatographic liquid on the entry plate of each module, as well as the evacuation of the chromatographic liquid.

2 - Modular device of chromatography according to 1a claim 1, characterized in that the chromatographic modules are of parallelepipedic form.

3 - Modular device of chromatography according to claim 1, characterized in that the chromatographic modules are of hexagonal form.

4 - Modular device of chromatography according to any of claims 1 to 3, characterized in that the entry and exit plates of each module are made of sintered plastic.

5 - Modular chromatography device according to any of which the elements of each module are such as are inserted between two modules, ensuring the distribution of the liquid on entry disc of the first module, the other ensuring the evacuation of the chromatographic liquid coming from the second module.

6 - Device according to any of claims 1 to 5, characterized in that the chromatographic column, made by stacking the modules, is laid out on a frame ensuring the tightening of the aforesaid elements and of the aforesaid modules between them.